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External Sustainability

A Stock Equilibrium Perspective

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The 1994 crisis in Mexico, developments in East Asia, and persistent turmoil in world financial markets have dramatized the role of external imbalances in macroeconomic crises Some believe that the current account should be kept from rising beyond a "sustainable" level, some that a current account surplus is the only solid external position Can those rules of thumb be justified analytically?

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Summary findings

Calderón, Loayza, and Servén consider external sustainability from the perspective of equilibrium in net foreign asset positions. Under their approach, an external situation is sustainable if it is consistent with international and domestic investors' achieving their desired portfolio allocation across countries.

They develop a reduced-form model of net foreign asset positions whose long-run equilibrium condition expresses the ratio of net foreign assets to the total wealth of domestic residents as a negative function of investment returns in the country relative to the rest of the world, a positive function of investment risk, and an inverse function of the ratio of foreign-owned to domestically owned wealth.

To estimate this equilibrium condition, the authors use a newly constructed data set of foreign asset and liability stocks for a large group of industrial and developing countries, from the 1960s to the present. They also develop summary measures of country returns and risks.

Their econometric methodology is an application of the Pooled Mean Group estimator recently developed by Pesaran, Shin, and Smith (1999), which allows for unrestricted cross-country heterogeneity in short-term dynamics while imposing a common long-run specification. The estimation results lend considerable support to the model, especially when applied to countries with low capital controls or high or upper-middle income. The results for countries with high capital controls and, especially, lower-income countries are less supportive of the stock equilibrium model.

As a byproduct of the model's estimation, the authors obtain estimates of the long-run equilibrium ratios of net foreign assets to wealth, conditional on the observed values of the country's relative returns, risks, and wealth. Then, for a selected group of industrial and developing countries, they evaluate the extent to which actual ratios diverge from their long-run counterparts — and hence the sustainability of current net foreign asset positions.

This paper — a product of the Poverty Reduction and Economic Management Unit, Latin America and the Caribbean Region — is part of a larger effort to assess the sustainability of the external accounts of the major countries in the region. Copies of the paper are available free from the World Bank, 1818 H Street, NW, Washington, DC 20433. Please contact Hazel Vargas, room I8-138, telephone 202-473-8546, fax 202-522-2119, email address hvargas@worldbank.org. Policy Research Working Papers are also posted on the Web at www.worldbank.org/research/workingpapers. The authors may be contacted at nloayza@condor.bcentral.cl or lserven@worldbank.org. January 2000. (43 pages)

Comments welcome

EXTERNAL SUSTAINABILITY: A STOCK EQUILIBRIUM PERSPECTIVE*

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EXTERNAL SUSTAINABILITY:
A STOCK EQUILIBRIUM PERSPECTIVE

1. Introduction

The Mexican crisis of 1994, as well as the 1997 developments in East Asia and the persistent turmoil in world financial markets, have brought to the fore the role of external imbalances in macroeconomic crises. While recent analytical literature has identified specific circumstances under which large current account imbalances may not be sufficient, or even necessary, for the occurrence of a crisis, few dispute the view that persistent large external deficits are a sure recipe for macroeconomic disaster.[1]

In this context, popular policy advice holds that the current account should be kept from rising beyond a "sustainable" level. Such recommendation lacks operational content given the difficulty of identifying that "sustainable" level, which has led many analysts to defend universally-applicable limits for current account deficits -- on the order of 3 percent of GDP, say. A more cautious view holds that the only solid external position is one of current account surplus.

These rules of thumb lack analytical justification and are often misleading because they ignore the role of country characteristics – like the availability of investment opportunities and the capacity to save – as well as the international context and dynamic factors behind external imbalances. All these ingredients can make a relatively low current account deficit unsustainable in one country at a given point in time (for example, 2.6% of GDP in Indonesia, 1991-97), while allowing much larger deficits to be sustained in another country for an extended period (for example, 5.2% of GDP in Peru, 1991-97). The objective of this paper is to provide both an analytical framework and empirical measures to help evaluate the sustainability of countries' external positions.

Analytical approaches to the sustainability of external positions are typically based on either of two approaches. The first one follows closely the arithmetic of intertemporal solvency. The second draws from the flow equilibrium approach to the current account, that views the

[1] Indeed, several recent empirical models assessing the determinants of external crises identify the current account imbalance as one of the factors behind exchange rate collapses (Berg and Pattillo 1998, Esquivel and Larrain 1998).

current account balance as the outcome of optimal saving and investment decisions by rational agents.

The *arithmetic of solvency* starts from the notion that an economy is intertemporally solvent if its (net) foreign indebtedness is no larger than the present discounted value of the stream of its future non-interest surpluses. The practical difficulty with this approach is that in principle any level of external debt is consistent with solvency provided that sufficient trade surpluses are generated in the indefinite future (Milesi-Ferreti and Razin 1996). Thus, to make this approach operational, researchers typically assume that the economy targets a given debt-to-output ratio, and consider the particular case in which current policy would remain unchanged into the indefinite future (Corsetti and Roubini 1991).[2] Hence, the notion of sustainability is popularly identified with the ability to maintain indefinitely the current policy stance without violating the intertemporal budget constraint (Milesi-Ferreti and Razin 1996).[3] One fundamental problem with this approach is that the level of targeted net liabilities need not be consistent with private agents' optimizing plans and, specifically, their desired asset holdings.

In turn, the *flow equilibrium* approach is based on the intertemporal approach to the current account, which views the latter as the equilibrium outcome of forward-looking saving and investment decisions by rational individuals, driven by expectations of productivity growth, government spending, interest rates, and other factors.[4] This framework has been commonly used for calculating "excessive" current account deficits, defined as significant departures from the equilibrium level, itself given by predictions about the future path of saving-investment determinants (Sachs 1981; Obstfeld and Rogoff 1995, 1996; Glick and Rogoff 1995; Razin 1995; Milesi-Ferreti and Razin 1996). In this manner, the saving-investment equilibrium approach does provide an analytical basis for the evaluation of external positions. Nevertheless, its almost

[2] The arithmetic of solvency is primarily concerned with the question of whether net external liabilities grow less rapidly than their (marginal) rate of return so that the present discounted value of net liabilities converges to some finite quantity. In practical terms, the arithmetic of solvency examines whether the net debt / GDP ratio grows more or less rapidly than the difference between the real interest rate and the economy's growth rate.

[3] The rationale is that at some point along an insolvent current account trajectory a (global or domestic) shock will eventually trigger off a balance of payments run and an external crisis.

[4] This view emphasizes the role of the current account as a buffer against transitory shocks in productivity or demand (i.e. transitory shocks in national cash flow) in order to smooth the intertemporally-optimal consumption path (Sachs 1981, 1982; Obstfeld and Rogoff 1996; Razin 1995; Ghosh and Ostry 1998).

exclusive concern with flows limits its ability to assess the viability and adequacy of external indebtedness -- a stock problem by nature.

In this paper we propose a third approach, according to which external sustainability is driven by portfolio equilibrium conditions in the long run and by the dynamics of asset reallocation in the short run. Long-run external equilibrium occurs when international and domestic investors achieve their desired portfolio allocation across countries. Thecorresponding short-run external equilibrium is given by the current-account balance consistent with acquiring the desired international portfolio, given any existing constraints to immediate portfolio adjustment.

The paper outlines a simple model of international portfolio diversification in which risk-averse investors allocate their wealth optimally across countries according to their relative returns and risks. Using a new cross-country time-series dataset on net foreign asset positions, we implement this approach empirically and assess quantitatively the level of external imbalances consistent with equilibrium asset allocation across countries.[5]

The paper's plan is as follows. Section 2 describes the methodological approach. It presents a Markowitz-Tobin model of portfolio diversification, according to which the ratio of a country's net foreign assets to its total wealth is a negative function of investment returns in the country relative to the rest of the world, a positive function of investment risk also relative to the world, and an inverse function of the ratio of foreign-owned to domestic-owned wealth. This defines the stock equilibrium towards which the economy converges gradually over time. The second part of section 2 presents the paper's econometric strategy to estimate this long-run relationship, allowing for short-run dynamic effects which can be heterogeneous across countries. Our empirical approach is based on the Pooled-Mean Group dynamic panel data estimator recently proposed by Pesaran, Shin, and Smith (1999), which combines the efficiency gains of restricting long-run parameters to be the same across units (countries in our case) with the flexibility of allowing short-run parameters to differ across coutries.

[5] We do recognize, however, that this approach might be of limited applicability in countries whose external indebtedness is partly driven by non-market forces, such as political interests or humanitarian reasons – e.g., low income countries (who are the main recipients of large aid flows), countries located in regions of geopolitical interest, and / or countries imposing stringent barriers to portfolio diversification. For this reason, in our empirical analysis we perform robustness checks by examining the validity of our basic model in various samples of countries defined according to income level and extent of barriers to portfolio diversification.

While our stock perspective is not new, its empirical applicability has been hampered by the lack of comprehensive data on foreign asset and liability stocks. In section 3 of the paper we present a new data set on foreign assets and liabilities, recently put together by Kraay, Loayza, Servén, and Ventura (1999), that covers a large number of developing and industrial countries and spans the years from 1965 to 1997. The section also describes the variables used to measure domestic investment returns and risks as well as wealth, relative to the rest of the world.

Section 4 presents the empirical results obtained estimating our panel error-correction model for various groups of countries. The model is first implemented on the full available sample, and robustness checks are then performed by estimating it on country groups that differ in per capita income level and restrictions to portfolio diversification. The estimated parameters are then used to gauge the degree of disequilibrium in external positions --judged from a stock perspective-- over time for selected sample countries.

Section 5 summarizes the main results and concludes by proposing extensions for further research.

2. Methodology

2.1 A stock approach to external sustainability

Our approach views external sustainability as driven by portfolio equilibrium conditions in the long run, and by the dynamic forces resulting from asset reallocation in the short run. Long-run external equilibrium is achieved when international and domestic investors obtain their desired portfolio allocation of assets across countries. The current account balance is just the mechanism through which investors acquire their desired asset positions.

However, imperfections in financial and factor markets may prevent the instantaneous achievement of the optimal portfolio. Short-run external equilibrium is then given by the current-account deficit consistent with the dynamics along the adjustment path towards investors' long-run equilibrium portfolio, which reflects existing constraints to immediate portfolio adjustment. These may arise from various sources (see Bacchetta and van Wincoop 1998) such as (i) investors' imperfect information (e.g., gradual learning about the state of the world, or about the permanence of reforms that initially enjoy imperfect credibility); (ii) congestion effects, such as increasing marginal costs to foreign investment due for example to its use of internationally immobile labor inputs; (iii) irreversibilities that make investment respond sluggishly to aggregate disturbances (Caballero 1994, Dixit and Pindyck 1996). While in our empirical implementation we allow for such dynamic effects, we do not model them explicitly here.

The purpose of the model we present below is to guide the econometric estimation by motivating the variables to be included in the regressions. Our starting point is the Markowitz-Tobin model of utility maximizing risk-averse investors. Their optimal portfolio allocation is based on two criteria, namely, maximization of mean returns and minimization of risk. Formally, let A represent the world assets and W, the wealth of world residents. Obviously, $A = W$. Let A_i represent country i's assets and W_i, the wealth of country i's residents. The assets in foreign countries and the wealth of foreigners are represented by $A\text{-}A_i$ and $W\text{-}W_i$, respectively.

Domestic and foreign investors may have different preferences, which includes the possibility of home-bias effects (Lewis 1999). Let, α_{ii} be the share of wealth of country i's residents desired to be allocated in country i's assets, and let α_{fi} represent the share of foreigners' wealth desired to be allocated in country i's assets. In accordance with the Markowitz-Tobin model, these portfolio shares are increasing in the anticipated return of country i's assets relative to those in the rest of the world, and decreasing in their perceived riskiness also relative to the rest of the world; we denote these two factors $RE_{i/f}$ and $RI_{i/f}$ respectively.

In (long-run) portfolio equilibrium, the desired holdings of country i's assets by both domestic and foreign residents should be equal to its total existing assets, that is,

$$\underbrace{\alpha_{ii}(RE_{i/f}, RI_{i/f})\, W_i}_{\text{desired holdings by domestic residents}} + \underbrace{\alpha_{fi}(RE_{i/f}, RI_{i/f})\,[W-W_i]}_{\text{desired holdings by foreign residents}} = A_i \tag{2.1}$$

The net foreign asset position of a country is the difference between the wealth owned by its residents and the assets located in the country. Therefore, in long-run equilibrium the net foreign asset position of country i will be given by,

$$NFA_i = W_i - [\alpha_{ii}\, W_i - \alpha_{fi}\, (W-W_i)]$$

$$\Rightarrow NFA_i = (1 - \alpha_{ii})\, W_i - \alpha_{fi}\, (W_f) \tag{2.2}$$

It will be convenient to normalize the variables by dividing both sides by country i's wealth:

$$\frac{NFA_i}{W_i} = 1 - \alpha_{ii} - \alpha_{fi}\left(\frac{W_f}{W_i}\right) \tag{2.3}$$

We can then express equation (2.3) as follows:

$$\frac{NFA_i}{W_i} = f(\overset{-}{RE}_{i/f}, \overset{+}{RI}_{i/f}, \overset{-}{W_f / W_i}) \qquad (2.4)$$

This expression defines the long-run equilibrium relationship resulting from optimal asset allocation across countries. For empirical implementation we shall take a linearapproximmation such as

$$y_i^* = \alpha_i + \beta_i X_i^* + \eta_i^* \qquad (2.5)$$

where y_i^* represents the long-run equilibrium stock of country i's net foreign assets (relative to its total wealth) and X_i^* represents measures of expected returns and perceived risks and the ratio of foreign to domestic wealth. In section 3 below we will discuss the construction of empirical measures of these variables.

2.2 Econometric Estimation

Empirical implementation of the model outlined in the previous sectionon a large cross-country time-series sample poses two main issues. First, the model defines a long-run relationship between the ratio of net foreign assets, wealth shares, and expected returns and risks. However, given the imperfections in international financial and factor markets, stock equilibrium does not hold in every point in time but is achieved gradually in the long run. Therefore, in the empirical analysis, the process of short-run adjustment must complement the long-run equilibrium model.

Second, it seems reasonable to assume that countries can differ in the market imperfections and barriers to portfolio reallocation that govern the short term dynamics – and perhaps even in the parameters characterizing the long-run equilibrium. Thus, we must take into account the very likely possibility of parameter heterogeneity across countries. We deal with each of these two issues in turn.

Single-country estimation

The challenge we face is to estimate long- and short-run relationships without being able to observe the long- and short-run components of the variables involved. Over the last decade or so, a booming cointegration literature has focused on the estimation of long-run relationships among I(1) variables in both univariate and multivariate frameworks (Johanssen 1995, Phillips and Hansen 1990).

In this paper we use instead standard methods of estimation and inference, along the lines recently proposed by Pesaran (1997) and Pesaran and Shin (1997). These are applicable regardless of whether the variables of interest are I(0) or I(1), and the main requirement for their validity is just that there exist only one long-run relationship among them (if this is not the case, similar multivariate methods are available; see Hsiao 1997).

In essence, this approach makes use of a general dynamic specification from which a long-run relationship and a short-run adjustment can be derived. Specifically, let's assume that the ratio of net foreign assets, y, follows an auto-regressive distributed lag model (ARDL). Furthermore, assume that the vector of explanatory variables, X, follows an auto-regressive process (AR). From this dynamic specification for y and X, an error-correction model is then derived to separate long- and short-run effects.

Although in actual estimation the order of the ARDL process is determined through information criteria, for ease of exposition let y follow an ARDL (1,1) process:

$$y_t = a + by_{t-1} + cX_t + dX_{t-1} + \upsilon_t \qquad (2.6)$$

where for simplicity we have dropped the country index i. Also for simplicity, let X be univariate and follow an AR(1) process (in actual estimation, the order of the AR process is chosen optimally):

$$X_t = \rho X_{t-1} + \varepsilon_t \qquad (2.7)$$

The set of explanatory variables is restricted to follow an AR process, which does not depend on contemporaneous values of y. This restriction follows from the assumption that there is only one long-run relationship between y and X (see Pesaran 1997). If a more general process for X were allowed, additional identification assumptions would be needed to discern between various long-run relationships, which is beyond the scope of this paper. However, it is possible to allow X to be endogenous in the sense that shocks in X may be correlated with contemporaneous shocks in y. With sufficient lags in the autoregressive processes of y and X, shocks in these variables can be safely assumed to be serially uncorrelated. Therefore, the shocks in y and X can be characterized as follows,

$$\begin{pmatrix} \nu_t \\ \varepsilon_t \end{pmatrix} iid(0, \Sigma), \qquad \Sigma = \begin{pmatrix} \sigma_{\nu\nu} & \sigma_{\nu\varepsilon} \\ \sigma_{\nu\varepsilon} & \sigma_{\varepsilon\varepsilon} \end{pmatrix} \qquad (2.8)$$

Although the kind of endogeneity allowed for in the econometric model does not account for reverse causality, it does consider the possibility of simultaneous causation by (serially uncorrelated) omitted variables. When $\sigma_{\nu\varepsilon}$ is non-zero, there will be a contemporaneous feedback between y and X. This must be taken into consideration when the long-run relationship is derived from the dynamic (ARDL) specification. Following Pesaran (1997), the endogeneity of X will be accounted for by parameterizing the effect of the contemporaneous correlation between ν and ε on the dynamic specification for y. Assume that ν and ε are jointly normal (which asymptotically is not restrictive). Therefore,

$$\nu_t = \left(\frac{\sigma_{\nu\varepsilon}}{\sigma_{\varepsilon\varepsilon}}\right)\varepsilon_t + \eta_t \qquad (2.9)$$

where $(\sigma_{\nu\varepsilon}/\sigma_{\varepsilon\varepsilon})$ represents the population coefficient of the regression of ν_t on ε_t, and η_t is distributed independently from ε_t (and, thus, from X_t).

Substitute the above expression for ν_t into y's ARDL model. Then, using the AR model for X, express ε_t in terms of X_t and X_{t-1}. The new residual in y's ARDL model is uncorrelated with all explanatory variables:

$$y_t = a + by_{t-1} + \left(c + \frac{\sigma_{\nu\varepsilon}}{\sigma_{\varepsilon\varepsilon}}\right)X_t + \left(d - \rho\frac{\sigma_{\nu\varepsilon}}{\sigma_{\varepsilon\varepsilon}}\right)X_{t-1} + \eta_t \qquad (2.10)$$

Note that equations (2.10) and (2.6) are observationally equivalent. This will be the case as long as the order of the AR process for X is less than or equal to the X-order of the ARDL process for y. If X_t is jointly endogenous, that is, if $\sigma_{\nu\varepsilon}$ is non-zero, then the coefficients on X_t and X_{t-1} obtained by simply running an OLS regression on (2.6) will be biased.

The long-run (steady-state) relationship implied by the dynamic system in equation (2.10) is given by

$$y^* = \left(\frac{a}{1-b}\right) + \left(\frac{c + d + \frac{\sigma_{\nu\varepsilon}}{\sigma_{\varepsilon\varepsilon}}(1-\rho)}{1-b}\right)X^* + \eta^* \qquad (2.11)$$

or, in terms of the reduced-form model given in the previous section, $y^* = \alpha + \beta x^* + \eta^*$.

Note that the estimation of the long-run coefficients α and β are not affected by the endogeneity of X. That is, α and β are the same functions of the coefficients on y_{t-1}, X_t, and X_{t-1}, taken either from (2.10) or, the observationally equivalent, (2.6).

In order to appreciate more clearly the long- and short-run relationships embedded in the ARDL model for y, let's express (2.10) in the form of an error correction model (ECM):

$$\Delta y_t = -(1-b)\left[y_{t-1} - \left(\frac{a}{1-b}\right) - \left(\frac{c + d + \frac{\sigma_{v\varepsilon}}{\sigma_{\varepsilon\varepsilon}}(1-\rho)}{1-b}\right) X_{t-1} \right] + \left(c + \frac{\sigma_{v\varepsilon}}{\sigma_{\varepsilon\varepsilon}}\right)\Delta X_t + \eta_t \qquad (2.13)$$

where the expression in brackets is the error-correction term and *(1-b)* is the speed of adjustment. Note that, as in the case of the long run coefficients, the short-run coefficients (that is, the coefficients on the error-correction term and on the change in X_t) are not affected by the endogeneity of X. In particular, the coefficient on ΔXt is equal to the coefficient on X_t in (2.10) (or the observationally equivalent (2.6)) and, thus, can be estimated by simply running an OLS regression on (2.10).

Multi-country estimation

Our empirical samples below are characterized by time-series (T) and cross-section dimensions (N) of roughly similar magnitude. In such conditions, there a number of alternative methods for multi-country estimation, which allow for different degrees of parameter heterogeneity across countries. At one extreme, the fully heterogeneous-coefficient model imposes no cross-country parameter restrictions and can be estimated on a country-by-country basis -- provided the time-series dimension of the data is sufficiently large. When, in addition, the cross-country dimension is also large, the mean of long- and short-run coefficients across countries can be estimated consistently by the unweighted average of the individual country coefficients. This is the "mean group" (MG) estimator introduced by Pesaran, Smith, and Im (1996). At the other extreme, the fully homogeneous-coefficient model requires that all slope and intercept coefficients be equal across countries. This is the simple "pooled" estimator.

In between the two extremes, there is a variety of estimators. The "dynamic fixed effects" estimator restricts all slope coefficients to be equal across countries but allows for different country intercepts. The "pooled mean group" (PMG) estimator, introduced by Pesaran, Shin, and Smith (1999), restricts the long-run coefficients to be the same across countries but allows the short-run coefficients (including the speed of adjustment) to be country specific. The PMG estimator also generates consistent estimates of the mean of short-run coefficients across countries by taking the unweighted average of the individual country coefficients (provided that the cross-sectional dimension is large). This estimator is particularly useful when, like in our case, the long run is given by country-independent equilibrium conditions while the short-run adjustment depends on country characteristics such as financial development and relative price flexibility. Furthermore, the PMG estimator is sufficiently flexible to allow for long-run coefficient homogeneity over only a subset of variables and/or countries.

The choice among these estimators faces a general trade-off between consistency and efficiency. Estimators that impose cross-country constraints dominate the heterogeneous estimators in terms of efficiency if the restrictions are valid. If they are false, however, the restricted estimators are inconsistent. In dynamic models in particular, imposing invalid parameter homogeneity typically leads to downward-biased estimates of the speed of adjustment (Robertson and Symons 1992, Pesaran and Smith 1995).

In view of these considerations, in this paper we use the pooled mean group estimator to test for the existence of a long-run relationship common across countries while allowing for unrestricted country heterogeneity in the adjustment dynamics. The interested reader is referred to Pesaran, Shin, and Smith (1999) where the PMG estimator is developed and compared with the MG estimator. Briefly, the PMG estimator proceeds as follows. The estimation of the long-run coefficients is done jointly across countries through a (concentrated) maximum likelihood procedure. Then the estimation of short-run coefficients (including the speed of adjustment) and country-specific error variances is done on a country-by-country basis, also through maximum likelihood and using the estimates of the long-run coefficients previously obtained.[6]

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[6] The comparison of the asymptotic properties of PMG and MG estimates can be put also in terms of the general trade-off between consistency and efficiency noted in the text. If the long-run coefficients are in fact equal across countries, then the PMG estimates will be consistent and efficient, whereas the MG estimates will only be consistent. If, on the other hand, the long-run coefficients are not equal across countries, then the PMG estimates will be inconsistent, whereas the MG estimator will still provide a consistent estimate of the mean of long-run coefficients across countries. The long-run homogeneity restrictions can be tested using Hausman or likelihood ratio tests to compare the PMG and MG estimates of the long run coefficients. In turn, comparison of the small sample properties of these estimators relies on their sensitivity to outliers. In small samples (low T and N), the MG estimator, being an unweighted average, is excessively sensitive to the inclusion of outlying country estimates (for instance those obtained with small T). The PMG estimator performs better in this regard because it produces estimates that are similar to *weighted* averages of the respective country-specific estimates, where the weights are given according to their precision (that is, the inverse of their corresponding variance-covariance matrix).

In all cases we assume that there is zero covariance between the error terms across countries. Non-zero error covariances usually arise from omitted common factors that influence all countries. In this paper, the common factors are modeled explicitly given thatthe measures of return, risk, and wealth of a given country are all relative to the rest of the world. Furthermore, to eliminate any remaining common factors, we also estimate the model allowing for time-specific effects. Given these considerations, the assumption of zero error covariances across countries is not overly restrictive.

3. Data

3.1 NFA and Wealth

The cornerstone of our data is a set of foreign asset and liability stocks for a large group of industrial and developing countries spanning the period from the 1960s to the present. The data set excludes 'small island' economies (specifically, those with population under 1 million in 1995)[7] as well as former socialist economies, for which data availability is too limited. In addition, we also drop from the basic data set a handful of developing countries that have experienced prolonged war episodes over the sample years. For our empirical experiments in this paper, we further restrict the country sample to those economies possessing a number of annual observations sufficient to allow country-specific econometric estimation; we set such minimum at 20 (consecutive) years. This results in an unbalanced panel of 48 countries with time coverage ranging from 20 to 33 years.

Construction of the data is thoroughly documented in Kraay *et al.* (1999), and for brevity we will limit our remarks here to the main issues.[8] The starting point is the definition of the net foreign asset position (NFA) of country j in year t:

$$\begin{aligned} NFA(j,t) &= NFQA(j,t) + NFLA(j,t) \\ &= \left[FDIA(j,t) - FDIL(j,t) + EQYA(j,t) - EQYL(j,t)\right] + \left[RA(j,t) + LA(j,t) - LL(j,t)\right] \end{aligned} \qquad (3.1)$$

[7] Small economies are excluded because they tend to display higher volatility than larger economies (Easterly and Kraay 1999), and this would add too much noise to our empirical experiments below. In addition, they also include a number of tax havens attracting disproportionately large financial flows, which would distort the cross-country dimension of the data.

[8] In the construction of the data set we have benefited from Lane and Milesi-Ferreti (1999), which documents a similar effort of estimation of foreign asset and liability positions. In this regard, several conversations with Gian Maria Milesi-Ferretti were particularly valuable.

where all variables are expressed in current US dollars. NFQA denotes the net holdings of equity-related assets and NFLA the net holdings of other assets, each given by the corresponding term in square brackets in the second line of (3.1). Using the letters A and L to denote respectively assets and liabilities, NFQA can be seen to equal the sum of the net holdings of direct foreign investment assets FDIA – FDIL plus the net holdings of portfolio equity assets, EQYA – EQYL. In turn, the second term in square brackets captures the net position in non-equity-related assets, that for brevity we shall call "loan assets". The position consists of international reserves RA, plus the net loan position LA – LL.

Absent valuation changes, unrequited capital transfers, debt forgiveness and other debt reduction operations, and ignoring misinvoicing of current account transactions, the rate of change of NFA would just equal the current account surplus CA, expressed in US dollars:

$$\Delta NFA(j,t) = CA(j,t) \tag{3.2}$$

Given some initial condition for NFA, recursive use of (3.2) would then permit construction of the country's net foreign asset position. Likewise, accumulation of disaggregated financial-account flows from the BoP would permit construction of each of the stocks in (3.1) above. But the conditions just mentioned under which historical flow accumulation would yield a good approximation to the value of the corresponding stocks are quite stringent. More specifically, correcting for the effects of unrequited capital transfers and debt reduction operations is relatively simple, as the relevant data is available from the IMF and the World Bank, but valuation effects are much more problematic. They arise from two main sources cross-exchange rate changes, whose effect depends on the currency composition of foreign assets and liabilities (generally unavailable from standard data sources), and changes in the secondary-market price of assets (e.g., equity prices in the case of portfolio investment, or market prices of developing-country debt). The latter valuation effects are even more difficult to estimate, as organized secondary markets often do not exist (particularly in developing countries).

Obviously, valuation problems could be easily overcome if information were available reporting asset stocks at current exchange rates and market prices. However, available stock information is limited to two main sources: (i) the foreign reserve data collected by the IMF's IFS, which value foreign exchange reserves at current exchange rates and have very broad coverage across countries and over time; and (ii) the external debt data compiled by the World

Bank and OECD for most developing countries starting in 1970, which report debt at face value (after adjusting for debt forgiveness and reduction as well as changes in exchange rates). In addition, we have also the international investment positions (IIPs) of the IMF's Balance of Payments, which cover the majority of industrial countries over a varying number of years since the 1980s as well as a handful of developing economies. The valuation methods underlying the BoP's IIPs vary across countries, as well as over time for a given country.[9]

In view of these facts, we take as primary data sources the IMF's IFS and BoP and the World Bank's Global Development Finance, complemented in a few cases by country-specific documents, typically from the respective central banks, plus the data on international investment positions constructed by Rider (1994) primarily for industrial countries.

From these sources, we construct our foreign asset and liability stocks as follows (see Kraay *et. al.* 1999 for more details). For reserves of all countries, as well as developing-country debt liabilities, we simply take the values reported by the IMF and the World Bank, respectively. For all other assets and liabilities, we construct stock series from the flows reported by theBoP, using the earliest available stock (if one exists) to tie down the level of the series.[10] From these initial values, stock series are obtained using the recursive formula:

$$S(t) = \frac{Q(t)}{Q(t-1)} S(t-1)(1-\delta) + F(t) \qquad (3.3)$$

where S denotes the dollar value of the stock at the end of the period, F is the net flow during the period, Q is the market price of the asset in current US dollars, and δ is a rate of physical depreciation. The key issue concerns the measurement of Q. In the case of FDI, we take Q to follow the replacement value of physical capital. For inward FDI, this is captured by the investment deflator of the host country. For outward FDI, a detailed breakdown of flows by destination is not available, and hence we use a weighted average of investment deflators, with

9 In a large number of cases, the asset figures reported by this source just reflect accumulated dollar flows at historical exchange rates, while in others some adjustments are introduced for exchange rate changes. In a few rare cases, the asset figures are expressed at market value.

10 For most countries, initial FDI stocks are obtained from OECD (1967), which reports direct investment assets of each industrial country disaggregated by country of destination; this provides also the basic source of initial values for developing-country inward FDI. For portfolio equity assets and liabilities, stock information is generally not available, although this is not too serious a problem given that portfolio flows are a relatively recent phenomenon; absent an initial stock, we set the starting value at zero. For industrial country loan assets and liabilities, as wll as for developing country loan assets, we take as initial stocks those reported by the BoP, Rider's (1994) data, or national sources whenever available.

weights given by the structure of intra-OECD FDI flows; we set δ at 4 percent. For portfolio equity liabilities EQYL, we set δ at 0 and measure Q by the domestic stock market price index (in US dollars), when one is available; otherwise, we use the same valuation as for FDI liabilities. In turn, for portfolio assets – whose breakdown across debtors is unavailable – we take Q to equal the Morgan-Stanley world stock market index.

So far we have ignored the problem of mis-measurement of capital flows and stocks. To attempt to capture unrecorded (net) assets, we augment our measure of recorded non-equity assets LA by adding to it the cumulative errors and omissions of the Balance of Payments, starting from the earliest date for which the information is available.[11]

Finally, we complement our information on foreign asset positions with data on wealth stocks. For each country and year in our sample, we define wealth as the sum of the country's net foreign asset position, plus its central bank's gold holdings and the value of its physical capital stock:

$$W(j,t) = NFA(j,t) + qK(j,t) + G(j,t) \tag{3.4}$$

where G and K respectively denote gold and capital stocks, and q is the unit value of the latter.

To calculate these wealth stocks, we first construct estimates of each country's physical capital stock. In order to do this, we extrapolate in the time-series and cross-section dimensions the Summers-Heston PPP-based investment and GDP series, on the basis of available constant-price investment and per capita GDP data. We next construct initial capital stock estimates for those countries lacking them by regressing average capital-output ratios (for countries with capital stock data in Summers-Heston) on per-capita income, and using the estimated regression coefficients to project the initial (average) capital/output ratios of the remaining countries. Finally, the capital stock series is computed by accumulating the PPP-based real investment flows to the initial stock.

In view of the narrow scope of stock markets in developing countries, as well as in the majority of industrial countries, we value these capital stocks in the same manner as FDI stocks,

[11] By the very nature of unrecorded assets, it is impossible to know their composition by currency and type of financial instrument, so that in this case we do not attempt to introduce any valuation adjustment.

namely by taking q in (3.4) to equal the replacement cost of capital.[12] In turn, we value physical gold stocks (taken from the IMF's IFS) at current market (London) prices.[13]

Using these estimated wealth stocks, we construct the foreign wealth / domestic wealth ratios of country i as the sum of wealth across all sample countries other than i divided by the wealth of country i.

3.2 Measures of return and risk

Apart from wealth ratios, the two key explanatory variables in our model of net foreign asset positions are the measures of anticipated risk and return for each country. In practice, these likely depend on a large variety of variables reflecting relative prices, profitability, transaction costs, property rights, tax regimes and so on. However, degrees-of-freedom considerations prevent us from including a large number of variables in the empirical estimation. In order to reconcile the need to consider all relevant variables with the requirement to maintain a sensible number of degrees of freedom, we summarize the information provided by pertinent variables in a few indices. These indices correspond to the categories introduced in equation (2.6). That is we construct, respectively, indices for expected returns ($RE_{i/f}$) and perceived risks ($RI_{i/f}$).

We construct each index as a weighted average of the principal components of its respective underlying indicators, where the weights are given by the share of the indicators' overall variance explained by each principal component. The principal components are derived from the indicators data pooled for all countries in the sample. The resulting index for each country would then be relative to the world and time sample average.

The underlying indicators for each index are listed below.[14] We have selected these indicators on the basis of both their relevance in previous theoretical and empirical work and

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[12] This valuation of capital is admittedly crude. We are aware that, if adjustment costs are present, conventional investment theory predicts that the market value and replacement costs of capital should diverge in the short run.

[13] We should note one major caveat concerning our constructed wealth measure, namely the neglect of non-reproducible assets (land, oil, etc), on whose volume and value little information is available for the vast majority of countries. Our definition of wealth in (3.4) above is admittedly incomplete in this regard, especially for resource-intensive countries.

[14] The main data sources are the World Development Indicators (World Bank), International Financial Statistics (IMF), Exchange Rate Arrangements (IMF), Civil Liberties Index (Freedom House), and Kaufman et al. (1999).

their data availability (see Milesi-Ferreti and Razin 1996, 1998; Easterly, Islam, and Stiglitz 1999; Rodrik 1999).[15]

Expected returns (RE):

- Overall productivity (measured by per capita GDP growth)
- Absence of price distortions (measured by the inverse of the black market premium)
- Financial depth (measured by the ratio of quasi-liquid liabilities to GDP)
- Openness (measured by the ratio of real imports plus real exports to GDP)
- Public institutional quality (measured by the Kaufman *et al.* index on governance and the Gastil index on civil liberties commonly used in the growth literature)
- Low tax burden (measured by the inverse of government consumption/GDP)
- Size and scale economies (measured by population size)

Risks (RI):

- General macroeconomic instability (measured by the standard deviation of per capita GDP growth)[16]
- Lack of international risk sharing in the composition of external liabilities (measured the ratio of debt liabilities to equity plus debt liabilities)
- Monetary and domestic-price instability (measured by the average and standard deviation of the annual inflation rate)
- External sector instability (measured by the standard deviation of real-exchange-rate changes, the standard deviation of terms of trade shocks, and the standard deviation of [real imports + real exports]/GDP)
- Low public institutional quality (measured by the inverse of the Kaufman et al. governance index and the inverse of the Gastil index on political and civil rights)
- Lack of financial depth (measured by the inverse of quasi-liquid Liabilities /GDP)

Having constructed the return and risk indices and estimated the level of wealth and NFA, we proceed to the empirical estimation of the model outlined in the previous sections.

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[15] Note that some variables (such as financial depth and governance quality) enter in both the return and risk measures. They do so because of their dual effect on the country's investment profile.

[16] The standard deviation of all listed variables is calculated as the standard deviation of observations corresponding to the current and four preceding years for each of the sample countries.

4. Empirical Results

We turn to the empirical implementation of the model on the above data. In order to assess in a transparent manner the robustness of the empirical results to the potentially very large degree of heterogeneity in our country sample, we break the latter into country groups that should be expected to be less heterogeneous, as follows. First, we divide the overall sample into two groups according to their per-capita income level. More specifically, using the World Bank's World Development Report income classification, we form one group consisting of industrial economies and high-income and upper-middle income developing economies – a total of 26 countries. Its complement is the group of low and lower-middle income developing economies (22 countries).

Next, anticipating the fact that our portfolio diversification model may be of limited applicability in environments of severely restricted capital flows, we also group the sample countries according to their respective capital account barriers. This poses some difficulties, however. The only available indicators of capital account restrictions with broad time-series and cross-country coverage are the IMF's Exchange Rate Restrictions, which include qualitative information on various types of measures that hamper international portfolio diversification -- (a) multiple exchange rate practices, (b) current account restrictions, (c) capital account restrictions, and (d) mandatory surrender of export proceeds. To combine all these indicators into a summary measure of portfolio restrictions, we sum them and compute the average for each country over the period 1965-97. If for a country the average is greater than or equal to three (implying that, on average, restrictions exist in at least three of the four categories during the sample period), we classify the country as having high capital controls. This procedure yields a subsample of 33 countries with low capital controls and 15 with high capital controls.[17]

Table 3.1 presents some descriptive statistics on the net foreign asset / wealth ratios for the full sample and the various country groups just defined. For the overall country sample, both the mean and median of country averages are negative, an indication of the fact that few countries possess net creditor positions. However, the figures reflect some systematic differences across country groups. Among higher income countries, as well as countries with moderate

[17] The countries in each subsample are listed in the appendix.

capital account restrictions, the median NFA/Wealth ratio is below the mean, reflecting the existence of a small group of large creditors. The opposite happens among lower income countries and countries with high capital controls, where the mean is below the median. Dispersion of the NFA ratios to wealth is also much higher for low-income than for high-income countries.

Figure 3.1 portrays the time path of the median NFA ratio for the overall sample and the high income and low income groups respectively. A cyclical pattern, particularly pronounced for the lower income countries, is apparent from the figure. Median NFA/Wealth ratios show a rising profile until the mid-1970s, followed by a decline that is especially steep and prolonged among the lower income group. After 1987, the median NFA ratio for lower income countries shows a strong recovery that extends until 1996.

4.1 Model estimation

Below we present econometric estimates for the full country sample as well as the subsamples just defined according to income level and capital account restrictions. In each case, we report estimates obtained using the raw data as well as those obtained adding time effects to account for possible common factors affecting all countries and not captured by the independent variables. [18]

In each case, we use the Schwartz Bayesian Criterion (SBC) to determine the dynamic specification for each country, subject to a maximum of two lags for each of the four variables in the model (nfa/wealth ratio, return, risk, and foreign/domestic wealth ratio). The specification selected in this way varies across countries, with the (2,0,0,1) and (2,0,0,2) ARDL specifications being the most frequent ones, although in a number of cases the SBC retained also lags of the risk and return indicators. We also experimented with imposing common dynamic specifications across countries; this obviously alters the short-run estimates but has a relatively minor effect on the long-run parameters.

Table 4.1 reports the full-sample estimates. The top panel presents the long-run coefficients; for comparison, we also report the Mean Group estimates. Focusing first on the specification without time effects, the restricted long-run coefficients carry the expected signs –

[18] We compute the latter estimates by implementing the model on the cross-section demeaned data – i.e., by subtracting from the raw data the mean for each sample year.

negative for the return variable and the foreign wealth/domestic wealth ratio, and positive for the risk variable. However, the return coefficient is not statistically significant. In contrast, the unrestricted MG estimates are less precise, and both the risk and return variables carry insignificant coefficients of the wrong sign. To a large extent, this reflects the sensitivity of the MG estimator to outliers in the country-specific estimates—specifically, Jamaica and Honduras yield very large coefficients on the risk and return variables which are of the wrong sign and statistically insignificant, but strongly bias the overall averages.[19] The joint Hausman test statistic cannot reject the PMG restrictions on the long-run coefficients, although the individual test statistics shown in the table provide some evidence against homogeneity of the long-run parameter of the return indicator.[20]

The bottom half of the table reports the average estimates of the speed of adjustment and the short-run parameters. As required for dynamic stability, the former is negative and significant; it is also somewhat smaller in magnitude in the PMG than in the MG specification (-.123 vs. -.181, respectively), in accordance with the theoretical prediction that pooling in the presence of heterogeneity tends to increase inertia (Robertson and Symons 1992). However, for four countries (Australia, Brazil, Mauritius and the U.S.) the SBC selects an unstable dynamic specification, and in a few other countries the estimated speed of adjustment is correctly signed but small in magnitude and statistically insignificant.

In turn, the average short-run parameters reveal significant lagged effects of the dependent variable and the foreign wealth / domestic wealth ratio, as well as the return variable in the case of the MG estimates. On the whole, the explanatory power of the model is rather satisfactory, and the average of the country-specific adjusted R^2 is .44 for the PMG specification (.65 for the MG specification). This is particularly encouraging in view of the large sample size (nearly 1,400 observations) and the simplicity of the model.

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[19] When these two countries are dropped from the sample, the long-run MG estimates carry the correct signs, but remain statistically insignificant. In turn, the PMG estimates, which are much more robust to outliers, show only modest changes.

[20] A likelihood ratio test would instead reject the constraints on the long-run parameters. However, the Hausman test may be preferable to assess the extent to which the constraints are grossly violated by the data. See Pesaran, Shin and Smith (1999).

The last two columns in Table 4.1 report the estimates obtained on the cross-sectionally demeaned data. Accounting for time effects raises the magnitude of the PMG estimates of the long-run parameters -- and, to a lesser extent, their standard errors too. The long-run coefficient on the return variable becomes now significant. The MG estimates are now of the correct signs, but only that on the return variable is significant; their values are again affected by a few large outliers (Costa Rica, Ireland and Saudi Arabia). As before, the long-run parameter restrictions are not rejected by the Hausman tests. Finally, the average speed of adjustment rises as well, especially in the case of the MG specification, and the model continues to account for a large portion of the variation in the de-meaned data..

Table 4.2 turns to the subsample of high and upper-middle income countries, for which the risk-return model might be expected to provide a better characterization of portfolio diversification than for the overall country sample. This expectation is borne out by the PMG estimates of the long run coefficients in the table, all of which are correctly signed and statistically significant. In particular, the return variable now carries coefficients much larger in absolute value than those in Table 4.1 above. Furthermore, the MG estimates carry also the correct signs and are fairly close to their PMG counterparts, although they remain imprecise.

The Hausman test statistics in Table 4.2 fail to reject the constraints on the long-run coefficients. The average speed of adjustment is somewhat lower than in the full-country sample when using the raw data, and higher when using the demeaned data, although the SBC-determined ARDL dynamics are still unstable in four countries, while some others (e.g., Singapore) display very slow adjustment. As before, the short-run coefficients show significant lagged effects of the foreign asset/wealth ratio and the foreign wealth /domestic wealth ratio. The estimated model fits the data fairly accurately. By way of example, Figure 4.1 plots the actual and fitted values of the dependent variable for 1996 (the last year with reasonably comprehensive sample coverage). The points cluster in a narrow region along the 45-degreee line. The pattern is very similar for other sample years.

Table 4.3 presents estimates for the sample of countries possessing low to moderate capital account restrictions, as earlier defined. Of the 33 countries included in this group, 22 belong also to the high and upper-middle income sample just analyzed. Like in the previous table, the PMG estimates of the long-run coefficients carry the correct signs and are statistically significant (although the return variable only reaches 10 percent significance in the specification without time effects). Most notably, the model with time effects yields long-run coefficient estimates very similar to those obtained in the high-income sample above. In contrast, the MG estimates are generally imprecise and in several cases incorrectly signed. Like in the full-sample results, this can be traced back to a couple of country-specific estimates very far from the overall average (Honduras and Jamaica when time effects are absent, and Costa Rica, Ireland, Jamaica and Saudi Arabia when they are included). In any case, the restrictions on the long-run coefficients imposed by the PMG specification are not rejected by the correspondingHausman tests, although there is some evidence against equality across countries of the coefficient on the risk indicator.

The estimated average speed of adjustment is fairly similar to that found in the high-income sample – indeed, they are virtually identical when using the model with time effects. As before, however, for a few countries the dynamics of the estimated model are unstable; this is the case of Australia and the U.S. if time effects are excluded, and Australia, Papua New Guinea and Uruguay if they are included. The average short-run coefficients show a pattern similar to that found earlier, although now there is also some evidence of lagged effects of the risk measure.

Results for the low and lower-middle income countries are reported in Table 4.4. Absent time effects, the PMG estimates of the long-run parameters are very similar to those obtained using the full sample (Table 4.1), with the return indicator not significantly different from zero. Heterogeneity across countries likely is the reason underlying this lack of precision, as suggested by the corresponding Hausman test, which is close to rejecting the null of homogeneity of the return coefficients. Adding time effects does not improve matters, as both the risk and return variables become wrongly signed and insignificant. The MG coefficients, again affected by a few outlying country-specific estimates, are even more problematic. In most cases they carry the wrong sign and are insignificant, regardless of whether time effects are included or not.

Finally, Table 4.5 presents estimation results using the sample of countries with high capital controls. The PMG estimates of the long run parameters carry the expected signs, but the return coefficient again is insignificant when time effects are omitted, and theHausman statistic testing the homogeneity of the return coefficient across countries shows clear evidence against the null. In contrast, when time effects are added the risk coefficient becomes insignificant. In both cases, the estimates of the risk and return parameters are considerably smaller than those obtained using the sample of countries with low capital account restrictions (Table 4.3 above). In turn, the MG estimates are fairly imprecise, with the exception of the return coefficient in the specification without time effects, which is significant at the 10 percent level but incorrectly signed.

The average speed of adjustment is similar to that found in the low capital controls sample if time effects are excluded, and marginally higher when they are included. In the former case, one country (Mauritius) displays unstable dynamics, and two (Mauritius and Brazil) do so in the latter case.

To summarize, the estimation results lend considerable support to the model when applied to countries with low capital controls and/or high and upper-middle income. Under the PMG specification, the long-run parameters carry the expected signs, are well determined (especially when time effects are included in the empirical specification), and the pooling restrictions are not rejected by Hausman tests. Moreover, the PMG estimates appear robust to outlying country-specific coefficients, which in contrast pose serious problems for the MG estimates.

The results for countries with high capital controls and, especially, lower-income countries, are less encouraging. For the former countries, this might be viewed as evidence that capital controls achieve some degree of success – they dampen the effects of risk and return factors on portfolio decisions. For the lower income countries, the likely reason is the limited role that optimal diversification decisions play in the observed evolution of net foreign assets, which may be dominated instead by other considerations such as the willingness of donor governments to extend, and forgive, concessional lending.

4.2 Actual vs. long-run equilibrium foreign asset ratios

As an important byproduct of the model's estimation, it is possible to obtain estimates of the long-run equilibrium NFA/wealth ratios conditional on the observed values of the explanatory variables. This permits an assessment of the extent to which actual ratios diverge from their long-run counterparts, and hence of the sustainability of current net foreign asset positions.

We perform this exercise below for a selected group of industrial and developing countries. Specifically, we use the long-run PMG estimates to construct the long-run equilibrium NFA/Wealth ratios. For this, we take the estimates from the high and upper-middle income sample, in which the model was found to have high explanatory power; results using instead the estimates from the sample of countries with low capital account restrictions were in most cases very similar.

The results from this exercise for various countries are presented in Figures 4.2 to 4.11. In each case, we plot the actual, fitted and long-run equilibrium NFA / wealth ratios. In all cases, it is apparent from the figures that the fit of the dynamic model is quite accurate, even at sharp turning points.

More interesting are the patterns of the long-run equilibrium values relative to the actual ones. Figure 4.2 plots the results for Argentina. The actual and fitted nfa / wealth ratio display a cycle of moderate increase until the early 1980s followed by a persistent decline thereafter. In contrast, the long-run equilibrium series experiences a rising trend since the late 1970s until 1991-92, a result of deteriorating returns and increasing risk (as measured by our risk/return indices) – largely a reflection of increasing macroeconomic instability over that period. As a consequence, a gap develops with the actual net foreign asset / wealth ratio remaining consistently below its equilibrium counterpart. The former is consistently negative, while the latter peaks at a small positive level in 1991-92. After that date, improving risk/return conditions bring the equilibrium series closer to the actual one, a process that appears to be partially reversed after 1995. At the end of the sample period, the gap remains considerable – which suggests that further motion towards equilibrium should entail current account surpluses in order to raise the actual net foreign asset position closer to its long-run level.

Figure 4.3 portrays results for Brazil. The broad trends in the actual and equilibrium series are similar: both remain negative throughout the sample period, and display a declining pattern until the early 1980s and a rise thereafter. Closer inspection reveals that the initial downward motion is largely driven by steadily high returns (mainly a reflection of rapid growth) and declining risk. After 1982-83, however, returns drop sharply, and this is followed by an upward swing in the risk index; on both accounts, the equilibrium nfa/wealth ratio rises back closer to zero. By the end of the sample period, the actual and equilibrium ratios are virtually identical.

In turn, Chile (Figure 4.4) shows a sharp decline in its equilibrium nfa/wealth ratios during the second half of the 1970s – a reflection of rising returns first and declining risk later. The noticeable rise in the equilibrium ratio after 1985 is largely driven by falling returns and, especially, by the steady declining foreign wealth / domestic wealth ratio, itself driven by rapid capital accumulation. This raises Chile's demand for foreign assets, bringing their equilibrium position close to zero.

The case of Mexico, portrayed in Figure 4.5, does not display such clear cycles. Both risk and return remain relatively steady, with the latter experiencing a sharp decline in 1977-81 that accounts for the marked rise in the equilibrium ratio. In the late 1980s, a rise in the risk index and a decline in the return index both tend to bring up the equilibrium series. Unfortunately, asset data for Mexico stop in 1994, when our estimates show a widening gap between the actual and equilibrium nfa / wealth ratios.

In Korea (Figure 4.6), large gaps between the actual and equilibrium series do not arise (with the exception of the year 1981) . The initial part of the sample period is characterized by high values of the return index, which declines steadily since the early 1980s. Risk declines too, but in a less pronounced manner, and rapid capital accumulation brings down the foreign / domestic wealth ratio and raises the demand for foreign assets, bringing the equilibrium asset position close to zero by the end of the sample period.

The distinguishing feature of Singapore (Figure 4.7) is that it displays a very large and persistent gap between the equilibrium and actual values of the foreign asset / wealth ratio. Our parameter estimates yield a very slow speed of adjustment, which accounts for the persistence of the divergence

Figures 4.8-4.11 portray industrial countries. In general, the gaps between actual and equilibrium nfa / wealth ratios are of a smaller order of magnitude than in developing countries. In Germany (Figures 4.8-4.9) the results suggest that at the end of the sample period foreign assets relative to wealth exceed their equilibrium value by a small amount, while the opposite happens in the U.K. In both cases, however, the equilibrium ratio is positive but small in magnitude, mostly reflecting the large wealth of these countries.

By contrast, in Canada (Figure 4.10) both the actual and equilibrium position remain negative throughout the sample period, and their divergences are mostly small. Both series display a rising pattern.

Finally, the U.S. (Figure 4.11) is a special case in that, as noted earlier, its estimated dynamics are unstable. As a result, the actual and equilibrium series show an increasingly large divergence. The equilibrium nfa / wealth ratio is positive and shows a modest rising trend reflecting mainly the steady increase in the country's relative wealth (especially since the early 1980s). In contrast, persistent current account deficits have resulted in an increasingly large debtor position for the U.S after the mid 1980s.

5. Conclusions

This paper proposes to consider external sustainability from the perspective of equilibrium in net foreign asset positions. According to this approach, an external situation is sustainable if two conditions are met. First, in the long run, international and domestic investors achieve their desired portfolio allocation of assets across countries. And second, in the short run, the current and capital-account flows are consistent with the reallocation of international capital to achieve the investors' desired stock positions.

Based on a standard Markowitz-Tobin model of portfolio diversification, the paper develops a reduced-form model of net foreign asset positions. The model yields a long-run equilibrium condition in which the ratio of NFA to the total wealth of domestic residents is a negative function of investment returns in the country relative to the rest of the world, a positive function of investment risk in the country relative to the rest of the world, and an inverse function of the ratio of foreign-owned to domestic-owned wealth. This long-run equilibrium condition guides the empirical analysis of the paper.

In order to estimate the equilibrium condition, the paper uses a newly constructed data set of foreign asset and liability stocks for a large group of industrial and developing countries spanning the period from the 1960s to the present (see Kraay, Loayza, Servén, and Ventura 1999.) With these data and estimates for the total capital stock in each country, the paper obtains a measure of the wealth of domestic residents in a country. In addition, the paper develops summary measures of country returns and risks. These are based on a comprehensive set of macroeconomic, policy, and institutional variables.

The econometric methodology of the paper is an application of the Pooled Mean Group estimator recently proposed by Pesaran, Shin, and Smith (1999). As a panel error-correction estimator, this method is well suited to the paper's objective given that it combines estimation of common long-run relationships across countries with the flexibility of estimating country-specific short-run dynamics.

The estimation results lend considerable support to the model when applied to countries with low capital controls and/or high and upper-middle income. First, the estimated parameters of the long-run relationship carry the expected signs and are statistically significance. That is, net foreign assets (as a ratio to total wealth) are negatively related to the measure of investment returns and the ratio of foreign to domestic wealth, and positively to the measure of investment risk. Second, the pooling restrictions of the PMG estimator (homogeneity of long-run parameters across countries) are supported by Hausman specification tests. Finally, the basic results appear robust to outlying observations and the inclusion of time effects.

The results for countries with high capital controls and, especially, lower-income countries, are less supportive of the stock equilibrium model. For the former countries, this might be viewed as evidence that capital controls achieve some degree of success – they dampen the effects of risk and return factors on portfolio decisions. For the lower income countries, the likely reason is the limited role that optimal diversification decisions play in the observed evolution of net foreign assets, which may be dominated instead by other considerations such as the willingness of donor governments to extend, and forgive, concessional lending.

As an important byproduct of the model's estimation, the paper obtains estimates of the long-run equilibrium NFA/wealth ratios conditional on the observed values of the explanatory variables. This permits an assessment of the extent to which actual ratios diverge from their long-run counterparts, and hence of the sustainability of current net foreign asset positions. The paper performs this exercise for a selected group of industrial and developing countries. By the end of the period, the net foreign asset positions of some countries under consideration appear to be close to their long-run equilibrium level (Chile, Korea, The U.K., and Germany), whereas for others (Argentina and the U.S.) the equilibrium NFA position seems to be considerably higher than the actual one. For the latter group of countries, the results would suggests that further motion towards equilibrium should entail a string of current account surpluses in order to raise the actual net foreign asset position closer to its long-run level.

APPENDIX

Determinants of the ratio of Net Foreign Assets to Wealth
Sample of Countries

			Income Level 1/		Capital Controls 2/	
Code	Country Name	Region	High & Upper-Middle	Low &Lower-Middle	Low	High
ARG	Argentina	AMER	X		X	
AUS	Australia	IND	X		X	
AUT	Austria	IND	X		X	
BGD	Bangladesh	SA		X		X
BLX	Belgium-Luxembourg	IND	X		X	
BOL	Bolivia	AMER		X	X	
BRA	Brazil	AMER	X			X
CAN	Canada	IND	X		X	
CHL	Chile	AMER	X			X
COL	Colombia	AMER		X		X
CRI	Costa Rica	AMER		X	X	
DEU	Germany	IND	X		X	
DOM	Dominican Republic	AMER		X		X
ECU	Ecuador	AMER		X	X	
ESP	Spain	IND	X		X	
FIN	Finland	IND	X		X	
GBR	United Kingdom	IND	X		X	
GHA	Ghana	SSA		X		X
HND	Honduras	AMER		X	X	
IND	India	SA		X		X
IRL	Ireland	IND	X		X	
ISR	Israel	MENA	X		X	
JAM	Jamaica	AMER		X	X	
JPN	Japan	IND	X		X	
KEN	Kenya	SSA		X		X
KOR	Korea	EAP	X		X	
MAR	Morocco	MENA		X		X
MEX	Mexico	AMER	X		X	
MUS	Mauritius	SSA	X			X
MWI	Malawi	SSA		X	X	
NGA	Nigeria	SSA		X		X
NLD	Netherlands	IND	X		X	
NPL	Nepal	SA		X	X	
NZL	New Zealand	IND	X		X	
PAK	Pakistan	SA		X		X
PER	Peru	AMER		X	X	
PNG	Papua New Guinea	EAP		X	X	
PRT	Portugal	IND	X		X	
PRY	Paraguay	AMER		X		X
SAU	Saudi Arabia	MENA	X		X	
SGP	Singapore	EAP	X		X	
THA	Thailand	EAP		X	X	
TTO	Trinidad and Tobago	AMER	X		X	
TUN	Tunisia	MENA		X	X	
TUR	Turkey	MENA	X			X
URY	Uruguay	AMER	X		X	
USA	United States	IND	X		X	
ZAF	South Africa	SSA		X		X

Notes: 1/The classification of countries by income level is based on the criterion used by the World Bank's World Development Report. 2/ The sub-sample of countries according to the presence of capital controls was based on the sum of capital controls dummies (1 for the presence of the restriction, and 0 otherwise) collected from the IMF's Exchange Arrangements and Exchange Restrictions. These dummies capture the presence of: (a) multiple exchange rate practices, (b) current account restrictions, (c) capital account restrictions, and (d) surrender of export proceeds. If the sum of these four categories was higher than or equal to three (i.e. presence of restrictions in at least three categories) on average over the 1965-97 period, we consider it a country with high capital controls. Otherwise, it is labeled a country with low capital controls.

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Table 3.1
Net Foreign Assets as percentage of Wealth
Descriptive Statistics

Period	1965-79	1980-89	1990-97	1965-97
1. All Countries				
Mean	-10,1%	-15,5%	-15,6%	-13,1%
Median	-9,0%	-12,6%	-11,4%	-11,0%
Standard Deviation	16,0%	18,7%	17,6%	16,1%
No. Observations	614	480	329	1423
2. High and Upper Middle Income Countries				
Mean	-3,7%	-6,8%	-6,6%	-5,2%
Median	-4,4%	-10,0%	-7,7%	-9,1%
Standard Deviation	13,0%	14,9%	10,7%	12,6%
No. Observations	329	260	194	783
3. Low and Lower Middle Income Countries				
Mean	-17,7%	-25,7%	-25,9%	-22,4%
Median	-14,1%	-21,6%	-21,3%	-19,2%
Standard Deviation	16,0%	17,7%	18,4%	14,9%
No. Observations	285	220	135	640
4. Countries with Low Capital Restrictions				
Mean	-8,6%	-12,8%	-13,3%	-11,0%
Median	-6,0%	-11,2%	-10,1%	-10,9%
Standard Deviation	17,8%	20,1%	17,4%	17,6%
No. Observations	411	330	233	974
5. Countries with High Capital Restrictions				
Mean	-13,5%	-21,3%	-20,8%	-17,5%
Median	-11,2%	-16,9%	-15,1%	-16,8%
Standard Deviation	10,6%	14,0%	17,4%	11,3%
No. Observations	203	150	96	449

Table 4.1
Determinants of the Ratio of Net Foreign Assets to Wealth (NFA/W)
Sample: All Countries, 1965-97

	No Time Effects			Time Effects	
Variables	"Pooled" Mean Group	Mean Group	Individual Hausman Test	"Pooled" Mean Group	Mean Group
A. Long-Run Parameters					
Return (RE)	-0,73082	0,213	0,07	-1,44951 **	-11,975 **
	(0,62)	(3,51)	(0,78)	(0,70)	(5,44)
		(0,06)			
Risk (RI)	5,55052 **	-10,193	2,89	6,60935 **	21,385
	(0,60)	(9,28)	(0,09)	(0,69)	(13,97)
Foreign/Domestic Wealth (Wf/Wi)	-0,00002 **	-0,002 **	1,46	-0,00006 **	-0.000
	(0,00)	(0,00)	(0,23)	(0,00)	(0,00)
Joint Hausman Statistic			5,27		4,36
(p-value)			(0,15)		(0,23)
Error Correction Coefficient	-0,123 **	-0,181 **		-0,148 **	-0,272 **
	(0,02)	(0,04)		(0,03)	(0,04)
B. Short-Run Parameters					
d [NFA/W (-1)]	0,153 **			0,093 **	
	(0,04)			(0,03)	
d RE	-0,177			-0,283 **	
	(0,13)			(0,13)	
d RE(-1)	0,01			-0,152	
	(0,06)			(0,16)	
d RI	-0,232			-0,221	
	(0,47)			(0,25)	
d RI(-1)	-0,569			-0,499	
	(0,30)			(0,42)	
d [Wf/Wi]	0,000			0,000 **	
	(0,00)			(0,00)	
d [Wf/Wi (-1)]	0,000 **			0,000	
	(0,00)			(0,00)	
Constant	-0,012 **			-0,004	
	(0,00)			(0,00)	
No. Countries	48			48	
No. Observations	1384			1384	
Average RBarSq	0,4408	0,6498		0,4019	0,6235
Log-Likelihood	3688,2	3992,7		3232,7	3514,3

Observations: * *Significant at 10 percent level,* ** *Significant at 5 percent level.*
Numbers in parenthesis below coefficient estimates are standard errors.
Numbers in parenthesis below the individual Hausman tests are p-values.

Table 4.2
Determinants of the Ratio of Net Foreign Assets to Wealth (NFA/W)
Sample: High and Upper-Middle Income Countries, 1965-97

Variables	No Time Effects "Pooled" Mean Group	 Mean Group	 Individual Hausman Test	Time Effects "Pooled" Mean Group	 Mean Group
A. Long-Run Parameters					
Return (RE)	-9,9596 **	-8,2820 **	0,28	-6,3192 **	-3,352
	(1,25)	(3,38)	(0,59)	(1,25)	2,81
Risk (RI)	2,1542 **	3,302	0,06	9,5615 **	8,356 **
	(1,08)	(4,79)	(0,81)	(1,18)	(3,93)
Foreign/Domestic Wealth (Wf/Wi)	-0,00004 **	-0,0030	1,56	-0,00028 **	-0.000 **
	(0,00)	(0,00)	(0,21)	(0,00)	(0,00)
Joint Hausman Statistic			1,86		4,35
(p-value)			(0,60)		(0,23)
Error Correction Coefficient	-0,091 **	-0,167 **		-0,214 **	-0,297 **
	(0,02)	(0,04)		(0,05)	(0,05)
B. Short-Run Parameters					
d [NFA/W (-1)]	0,186 **			0,232 **	
	(0,06)			(0,06)	
d RE	0,13			-0,407	
	(0,19)			(0,40)	
d RE(-1)	0,14			-0,153	
	(0,10)			(0,27)	
d RI	0,199			-0,309	
	(0,41)			(0,52)	
d RI(-1)	-0,752			-0,261	
	(0,54)			(0,44)	
d [Wf/Wi]	0,000			0,000 *	
	(0,00)			(0,00)	
d [Wf/Wi (-1)]	0,000 **			0,000	
	(0,00)			(0,00)	
Constant	-0,006 **			-0,02 **	
	(0,01)			(0,01)	
No. Countries	26			26	
No. Observations	755			755	
Average RBarSq	0,3954	0,5888		0,2180	0,4888
Log-Likelihood	2170,5	2321,8		1929,4	2117,2

Observations: ** Significant at 10 percent level, ** Significant at 5 percent level.*
Numbers in parenthesis below coefficient estimates are standard errors.
Numbers in parenthesis below the individual Hausman tests are p-values.

Table 4.3
Determinants of the Ratio of Net Foreign Assets to Wealth (NFA/W)
Sample: Countries with Low Capital Controls, 1965-97

Variables	No Time Effects			Time Effects	
	"Pooled" Mean Group	Mean Group	Individual Hausman Test	"Pooled" Mean Group	Mean Group
A. Long-Run Parameters					
Return (RE)	-1,36153 *	-1,764	0,01	-5,74583 **	-13,529
	(0,80)	(4,96)	(0,93)	(1,03)	(8,93)
	1,71				
Risk (RI)	6,07782 **	-16,289	2,84	7,67645 **	-12,513
	(0,72)	(13,30)	(0,09)	(0,86)	(11,93)
Foreign/Domestic	-0,00002 **	-0,002	1,73	-0,00003 **	0,000
Wealth (Wf/Wi)	(0,00)	(0,00)	(0,19)	(0,00)	(0,00)
Joint Hausman Statistic			6,68		4,30
(p-value)			(0,08)		(0,23)
Error Correction	-0,129 **	-0,178 **		-0,213 **	-0,275 **
Coefficient	(0,02)	(0,04)		(0,04)	(0,05)
B. Short-Run Parameters					
d [NFA/W (-1)]	0,143 **			0,112 **	
	(0,05)			(0,04)	
d RE	-0,129			-0,078	
	(0,14)			(0,21)	
d RE(-1)	-0,022			-0,192	
	(0,08)			(0,24)	
d RI	-0,624			-0,853	
	(0,51)			(0,51)	
d RI(-1)	-0,871 **			-0,653	
	(0,43)			(0,57)	
d [Wf/Wi]	0,000			0,000 **	
	(0,00)			(0,00)	
d [Wf/Wi (-1)]	0,000 *			0,000	
	(0,00)			(0,00)	
Constant	-0,01 **			0,006	
	(0,01)			(0,01)	
No. Countries	33			33	
No. Observations	941			941	
Average RBarSq	0,4100	0,6333		0,2755	0,5727
Log-Likelihood	2573,8	2793,0		2231,2	2419,6

Observations: ** Significant at 10 percent level, ** Significant at 5 percent level.*
Numbers in parenthesis below coefficient estimates are standard errors.
Numbers in parenthesis below the individual Hausman tests are p-values.

Table 4.4
Determinants of the Ratio of Net Foreign Assets to Wealth (NFA/W)
Sample: Low and Lower-Middle Income Countries, 1965-97

Variables	No Time Effects			Time Effects	
	"Pooled" Mean Group	Mean Group	Individual Hausman Test	"Pooled" Mean Group	Mean Group
A. Long-Run Parameters					
Return (RE)	-0,4882	10,253 *	3,35	1,5820	-0,696
	(0,83)	(5,93)	(0,07)	(1,05)	(13,80)
Risk (RI)	5,8059 **	-26,142	2,80	-0,1923	-1,13
	(0,80)	(19,12)	(0,09)	(0,68)	(10,04)
Foreign/Domestic Wealth (Wf/Wi)	-0,0000183 **	0,000	0,31	-0,00002 **	0,000
	(0,00)	(0,00)	(0,58)	(0,00)	(0,00)
Joint Hausman Statistic			3,95		0,74
(p-value)			(0,27)		(0,86)
Error Correction Coefficient	-0,153 **	-0,198 **		-0,167 **	-0,237 **
	(0,03)	(0,06)		(0,03)	(0,05)
B. Short-Run Parameters					
d [NFA/W (-1)]	0,096 **			0,026	
	(0,04)			(0,02)	
d RE	-0,42			-0,100	
	(0,23)			(0,30)	
d RE(-1)	-0,035			-0,843	
	(0,11)			(0,52)	
d RI	-0,548			-0,040	
	(0,90)			(0,36)	
d RI(-1)	-0,355			0,000	
	(0,25)			(0,00)	
d [Wf/Wi]	0,000			0,000 **	
	(0,00)			(0,00)	
d [Wf/Wi (-1)]	0,000 **			0,000	
	(0,00)			(0,00)	
Constant	-0,026 **			0,002	
	(0,01)			(0,00)	
No. Countries	22			22	
No. Observations	629			629	
Average RBarSq	0,5318	0,7218		0,5023	0,6682
Log-Likelihood	1528,7	1670,8		1325,5	1433,5

Observations: ** Significant at 10 percent level, ** Significant at 5 percent level.*
Numbers in parenthesis below coefficient estimates are standard errors.
Numbers in parenthesis below the individual Hausman tests are p-values.

Table 4.5
Determinants of the Ratio of Net Foreign Assets to Wealth (NFA/W)
Sample: Countries with High Capital Controls, 1965-97

Variables	No Time Effects			Time Effects	
	"Pooled" Mean Group	Mean Group	Individual Hausman Test	"Pooled" Mean Group	Mean Group
A. Long-Run Parameters					
Return (RE)	-0,35901	4,563 *	4,53	-2,3155 **	-16,341
	(0,99)	(2,52)	(0,03)	(0,73)	(17,69)
Risk (RI)	4,55984 **	3,218	0,12	0,1266	6,275
	(1,11)	(4,10)	(0,73)	(0,49)	(6,15)
Foreign/Domestic Wealth (Wf/Wi)	-0,00005 **	-0,000005	0,77	-0,0001 **	0,000
	(0,00)	(0,00)	(0,38)	(0,00)	(0,00)
Joint Hausman Statistic			5,38		2,81
(p-value)			(0,15)		(0,42)
Error Correction Coefficient	-0,126 **	-0,187 **		-0,245 **	-0,346 **
	(0,04)	(0,06)		(0,07)	(0,07)
B. Short-Run Parameters					
d [NFA/W (-1)]	0,174 **			0,084 **	
	(0,07)			(0,04)	
d RE	-0,281			-0,235	
	(0,29)			(0,19)	
d RE(-1)	0,07			-0,463	
	(0,07)			(0,38)	
d RI	0,634			0,053	
	(0,95)			(0,41)	
d RI(-1)	0,076			0,000	
	(0,11)			(0,00)	
d [Wf/Wi]	0,000			0,000 **	
	(0,00)			(0,00)	
d [Wf/Wi (-1)]	0,000 **			0,000	
	(0,00)			(0,00)	
Constant	-0,02 **			-0,028 **	
	(0,01)			(0,01)	
No. Countries	15			15	
No. Observations	443			443	
Average RBarSq	0,5167	0,6860		0,4547	0,6393
Log-Likelihood	1116,8	1199,7		938,8	1025,3

Observations: ** Significant at 10 percent level, ** Significant at 5 percent level.*
Numbers in parenthesis below coefficient estimates are standard errors.
Numbers in parenthesis below the individual Hausman tests are p-values.

Figure 3.1
NFA/W Medians, 1966-97

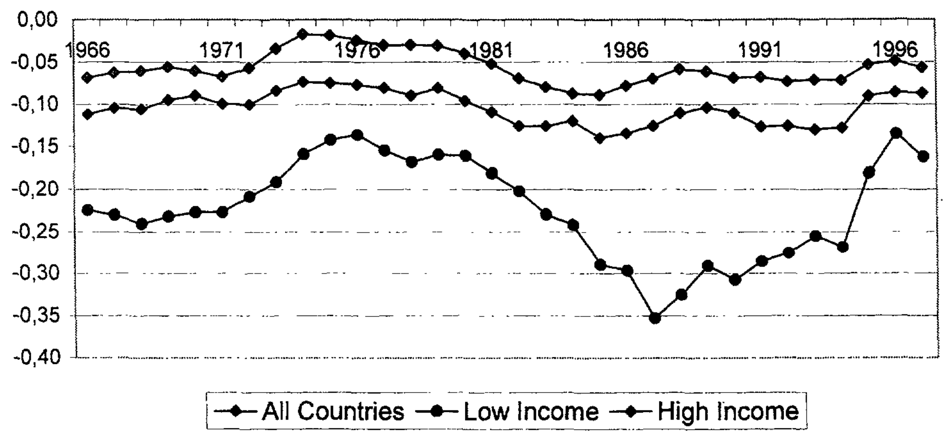


Figure 4.1:Actual vs. Fitted NFA / W: High- and Upper-Middle Income Countries, 1996

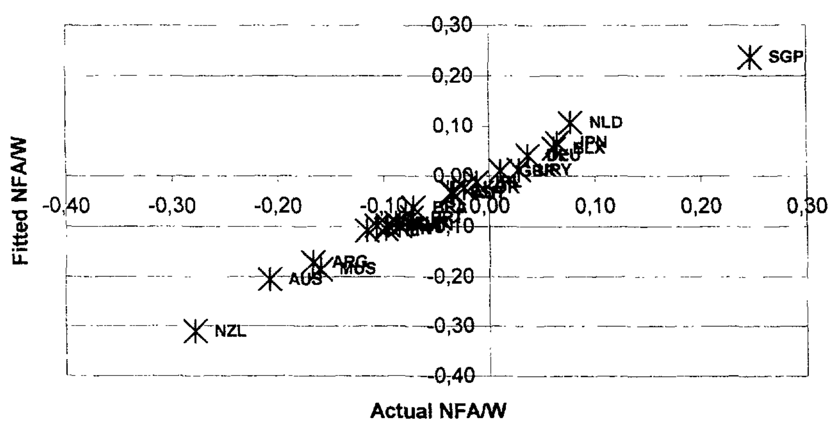


Figure 4.2: Actual, Fitted and Long-Run NFA/W: Argentina, 1966-97

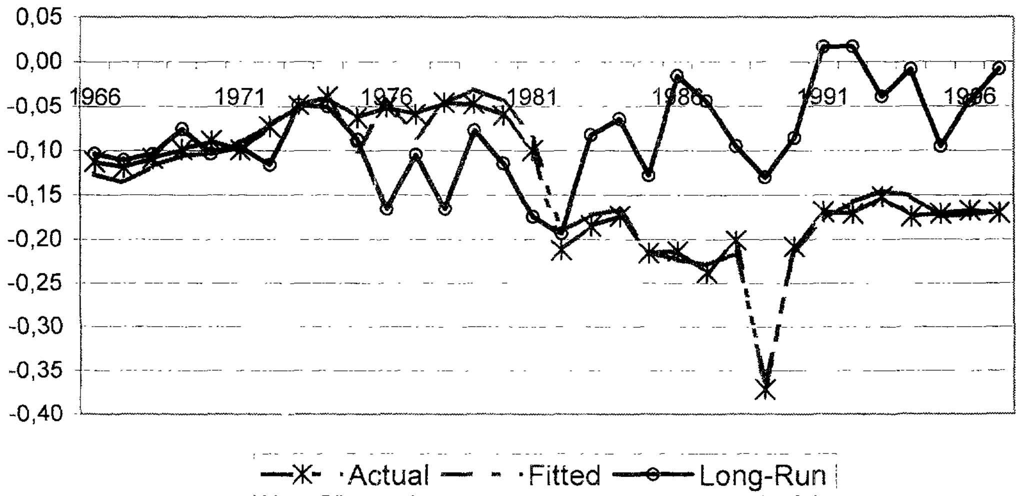


Figure 4.3: Actual, Fitted and Long-Run NFA/W: Brazil, 1968-97

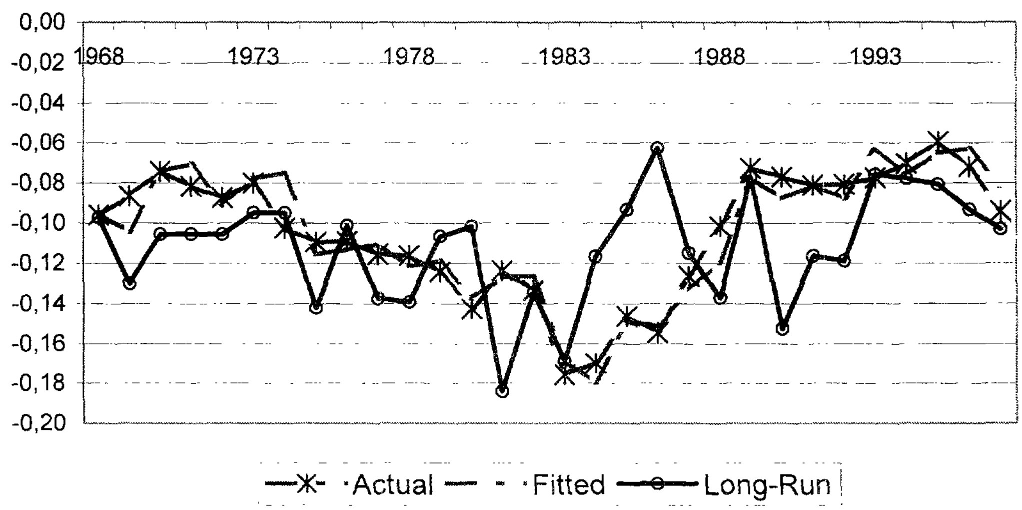


Figure 4.4:Actual, Fitted and Long-Run NFA/W: Chile, 1968-97

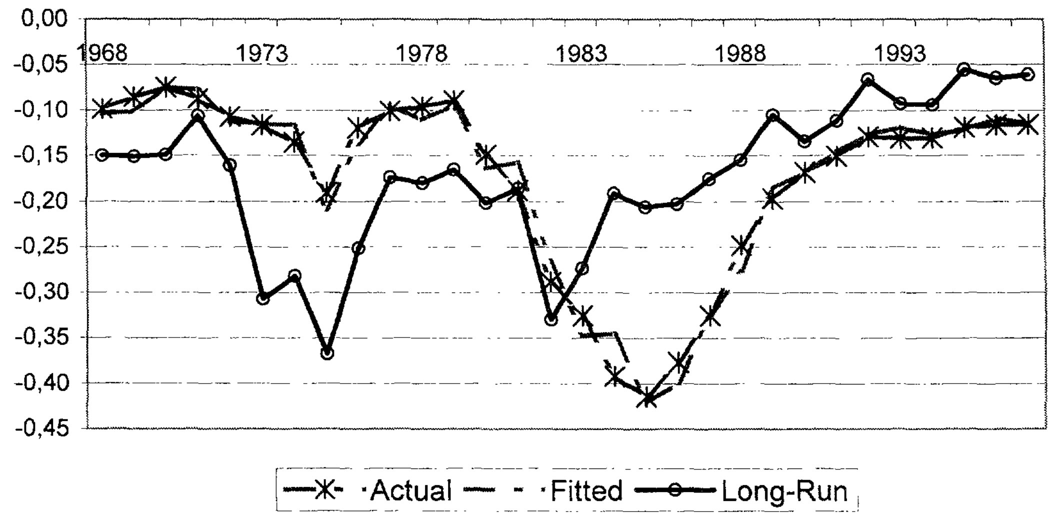


Figure 4.5:Actual, Fitted and Long-Run NFA/W: Mexico, 1968-94

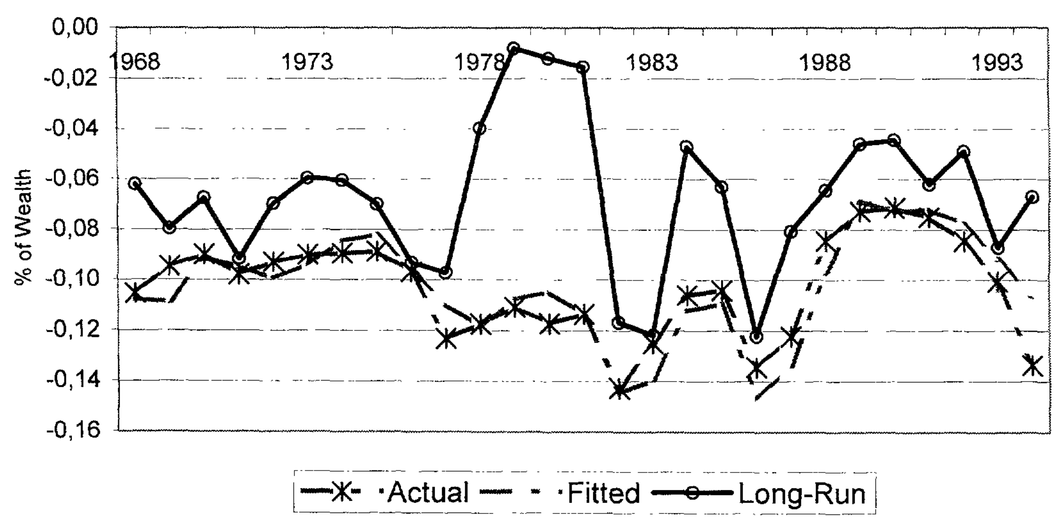


Figure 4.6: Actual, Fitted and Long-Run NFA/W: Korea, 1971-96

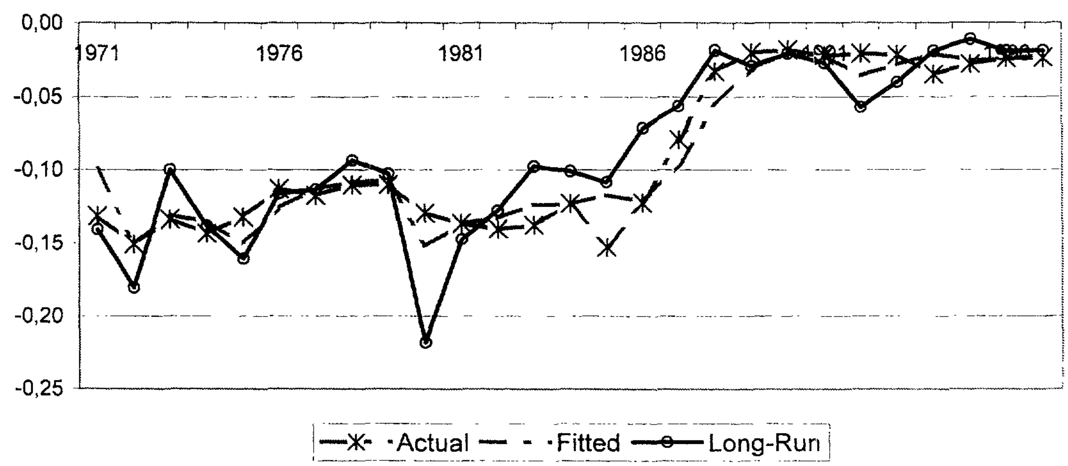


Figure 4.7: Actual, Fitted and Long-Run NFA/W: Singapore, 1971-96

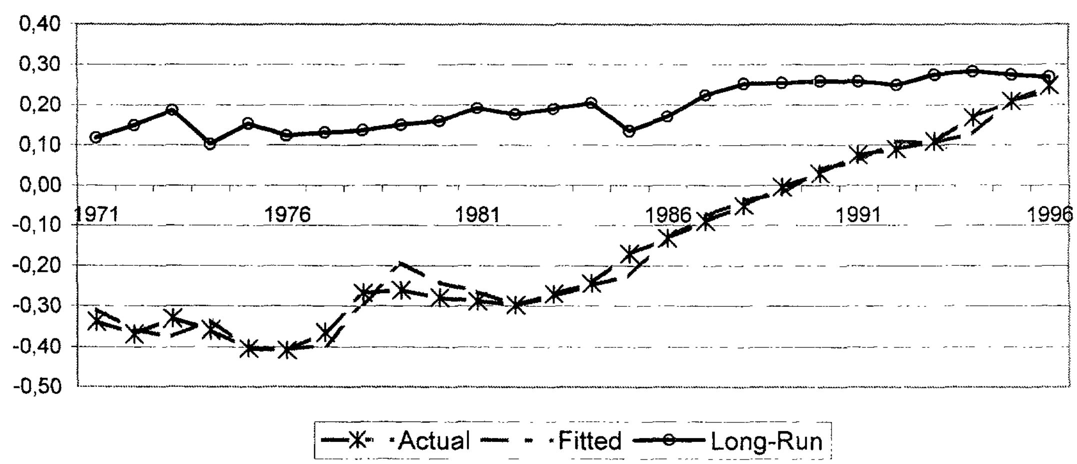


Figure 4.8:Actual, Fitted and Long-Run NFA/W: Germany, 1966-96

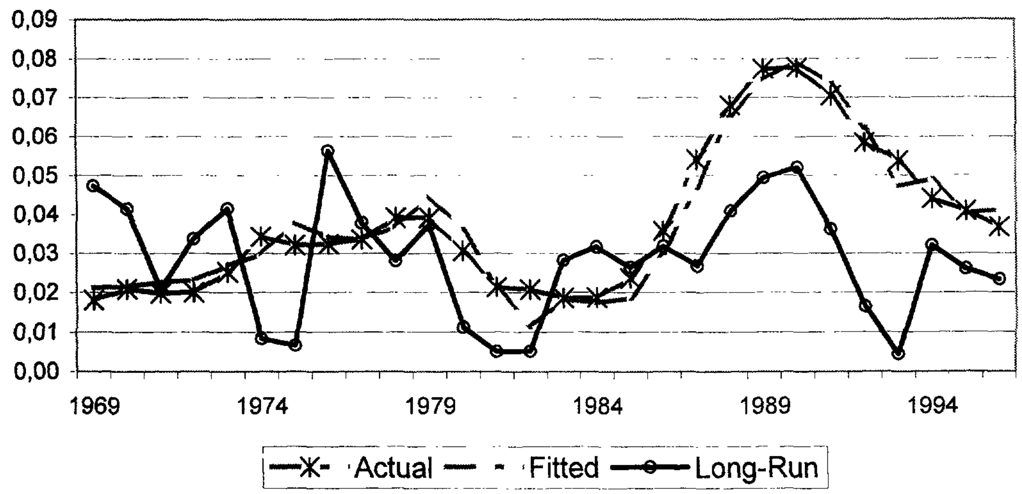


Figure 4.9:Actual, Fitted and Long-Run NFA/W: United Kingdom, 1967-96

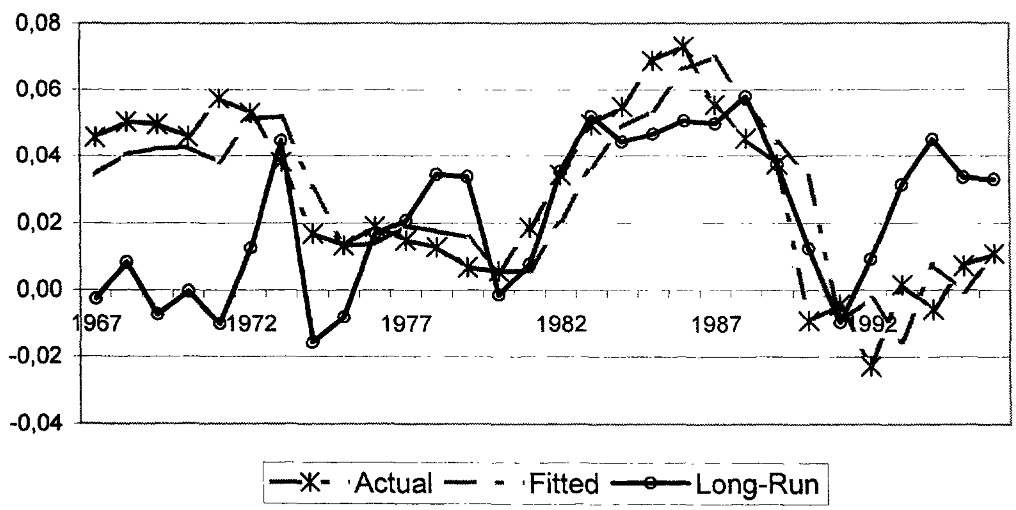


Figure 4.10:Actual, Fitted and Long-Run NFA/W: Canada, 1966-96

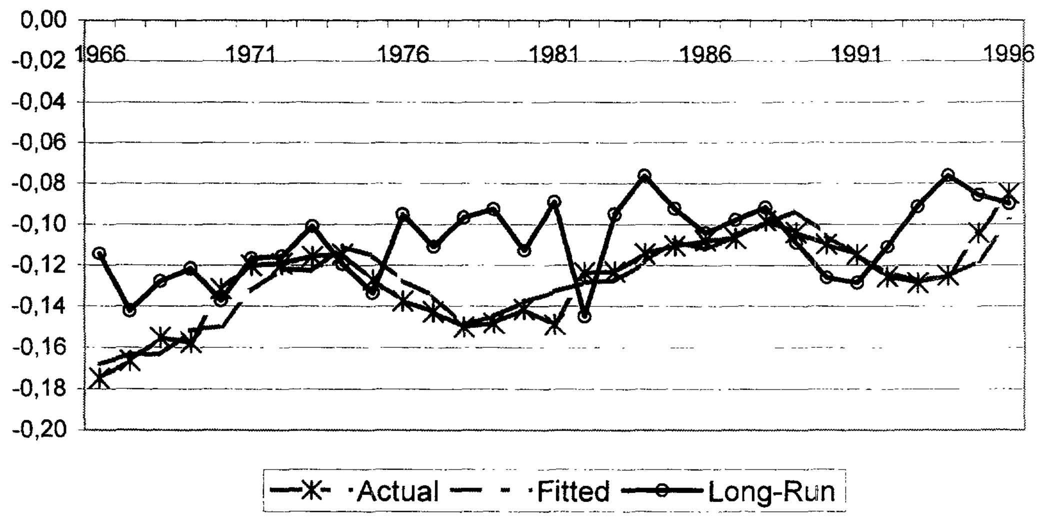
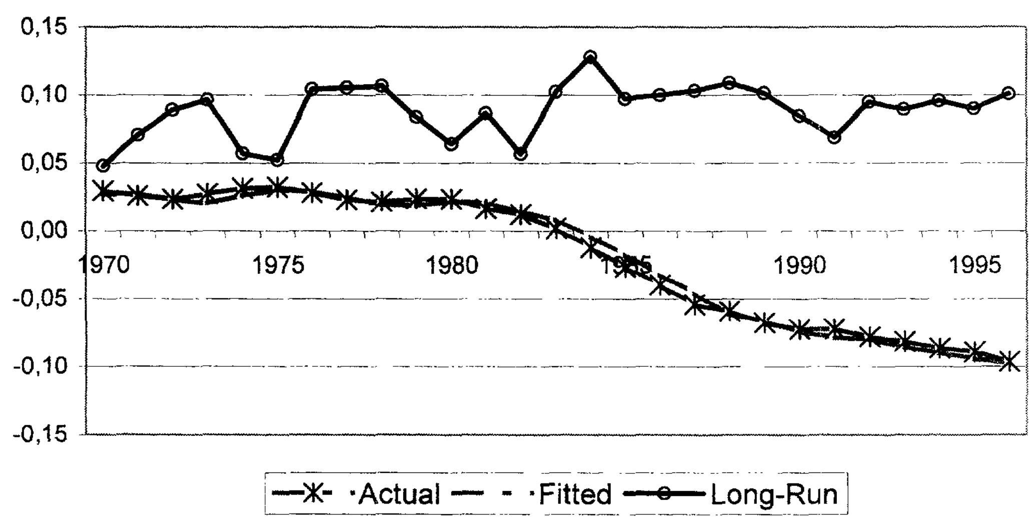


Figure 4.11:Actual, Fitted and Long-Run NFA/W: United States, 1970-96



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